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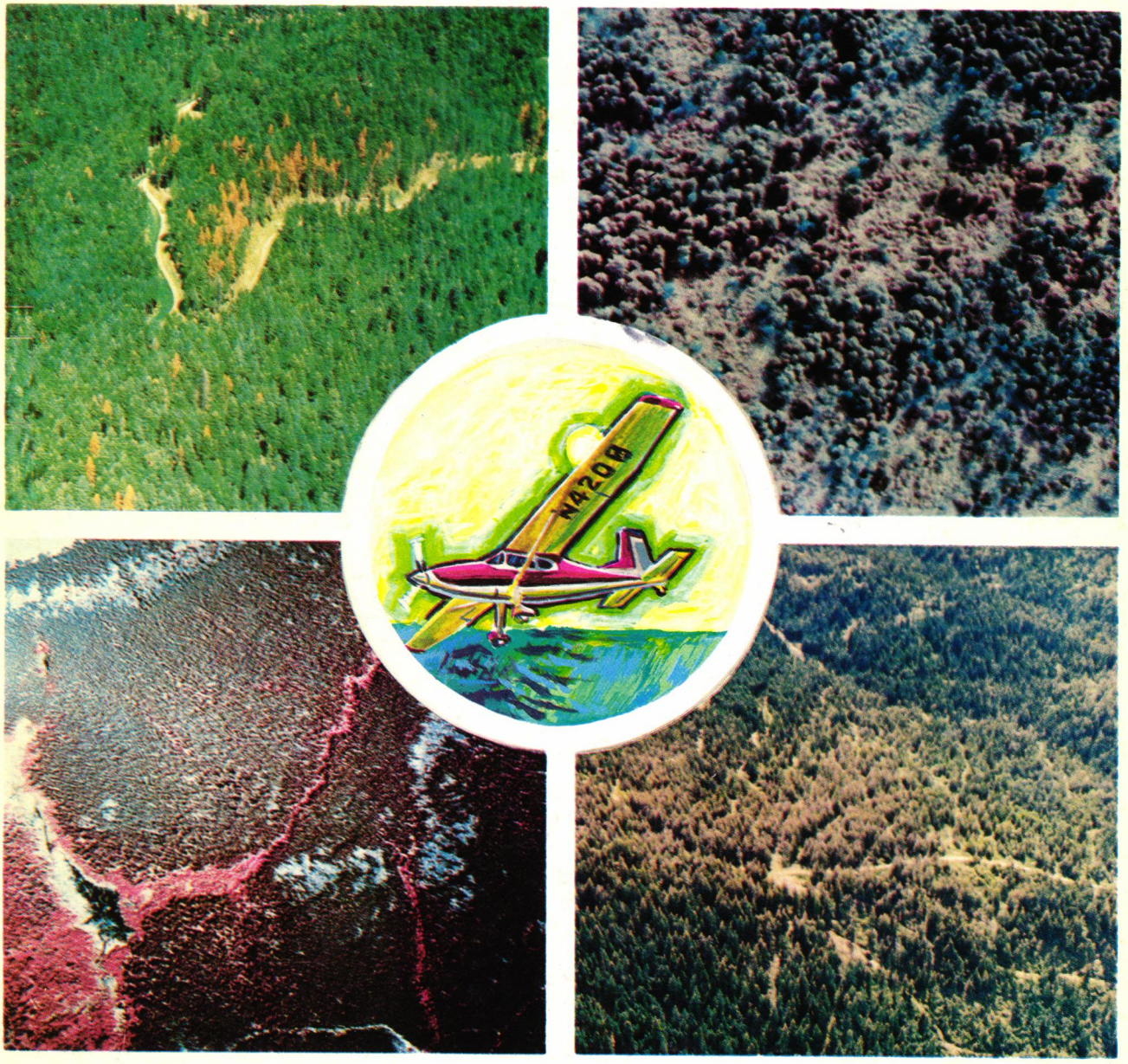
1974

FOREST INSECT & DISEASE CONDITIONS

in the Northern Region 1974



FOREST ENVIRONMENTAL PROTECTION

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COVER

Aerial surveys, both sketch mapping and use of aerial photography, are valuable aids in detecting, evaluating, and assessing impacts of destructive insect and disease pests. Some typical views of insect and disease damage in the Northern Rocky Mountains, beginning at upper left and proceeding clockwise, are as follows:

True fir killed by fir engraver, *Scolytus ventralis* Lec.

Color infrared aerial photograph of mortality caused by root rot, *Poria weirii* (Murr.) Murr. in northern Idaho. Opening in forest canopy with dense shrubby appearance is epicenter; dead (blue) and dying (light magenta) trees surround the epicenter.

Color infrared photograph of fluoride and insect damage near an aluminum plant in western Montana. An extensive area of conifer damage (blue-grey tones) contrasts with the healthy broadleaf vegetation (red).

Defoliation of Douglas-fir and grand fir by Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. in northern Idaho.

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INTRODUCTION

There has been developing an increased interest in the protection of our forest resource from insects, diseases, and more recently, from air pollutants. This has occurred largely because of man's increased awareness of the destructive capabilities of these agents and the heavy tolls they take of our limited supplies of commercial timber, recreational space, and other forest resource values. Not only do they reduce the potential productivity of our forests, but they also damage scenic, recreational, and watershed values. Given adequate knowledge of the habits, behavior, and impacts caused by insects and disease, it is possible to reduce or even prevent such losses.

The mission of entomologists and pathologists of the Forest Service's Northern Region is to reduce losses caused by forest insect and disease pests. In their effort to more fully accomplish these goals, they annually conduct aerial and ground detection surveys designed to discover incipient pest populations. Once detected, infestations are evaluated to measure their severity, potential for future damage, and need for control. These surveys assist forest resource managers in planning programs of suppression to prevent losses.

The purpose of this publication is to review status of important forest insects and diseases in the Region during 1974, highlight the significant progress made in combating certain pests, and provide an outlook for the coming year.

STATUS OF FOREST INSECTS

Conditions in Brief

A variety of insects damaged forests in the Northern Region during 1974. Douglas-fir tussock moth was the target of an aggressive control program which included operational spraying of 75,300 acres in Idaho. Several pilot control projects of chemical and biological agents were also conducted in northern Idaho and western Montana. Western spruce budworm defoliated approximately 4.2 million acres of Douglas-fir, true fir, and Engelmann spruce forests in Idaho and Montana. Larch casebearer damage increased on the Flathead, Kootenai, and Lolo National Forests in Montana and on the Clearwater National Forest in Idaho. Western false hemlock looper populations declined in intensity although total areas of visible defoliation remained about the same. Pine needle sheath miner populations increased in lodgepole pine stands in Glacier National Park and on the Flathead and Gallatin National Forests, Montana, and Idaho Panhandle National Forests, Idaho.

Lodgepole pine stands continued to sustain heavy losses by mountain pine beetle on the Gallatin, Kootenai, and Lolo National Forests. New infestations developed in lodgepole pine stands on the Beaverhead National Forest. The Yellowstone National Park infestation stabilized. Second-growth ponderosa pine stands suffered increased losses from mountain pine beetle during the year in Montana. Major infestations occurred on the Bitterroot, Lolo, Helena, and Lewis and Clark National Forests.

Infestations of Douglas-fir beetle declined for the third consecutive year in the North Fork Clearwater River drainage. Pine engraver beetle activity increased in the Northern Region, particularly in Montana, due to drought conditions in the Region during 1973. Fir engraver caused tree mortality in grand fir stands on the Nezperce, Clearwater, and Idaho Panhandle National Forests in Idaho, and on the Flathead and Lolo National Forests in Montana.

A defoliating weevil damaged 700 acres of precommercially thinned lodgepole pine on the Lewis and Clark National Forest, Montana. Forest tent caterpillar defoliated several species of hardwoods in river bottoms. An active infestation of ash borer damaged shelterbelt plantings of green ash in southwestern North Dakota. Losses occurred in Christmas tree production areas due to damage caused by the Douglas-fir needle miner.

MAJOR DEFOLIATORS

DOUGLAS-FIR TUSSOCK MOTH, *Orgyia pseudotsugata* McDonald (Figure 1).

Figure 1.--Mature Douglas-fir tussock moth larva on Douglas-fir.

The Douglas-fir tussock moth outbreak continued through 1974. Approximately 115,000 acres of Federal, State, and private lands were infested in northern Idaho in 1974. An additional 11,150 acres were infested in

western Montana (Figure 2). An action program was formulated which called for treatment of approximately 87,000 acres in northern Idaho with DDT under emergency use authority. In addition, a large-scale pilot control project of two microbial materials, *Bacillus thuringiensis* Ber. and a nucleopolyhedrosis virus, was also planned for two areas in Idaho totaling 27,000 acres. Localized infestations in Montana were used as sites for pilot control projects of Sevin-4-oil (carbaryl) and *B. thuringiensis*.

The DDT effort proceeded successfully with an overall target insect mortality of 99.5 percent. Insecticide was applied at the rate of three-fourths pound per acre in 1 gallon of oil carrier. Application was by a 205 Bell helicopter which had a treatment capability of 1,000 acres per hour (Figure 3). A total of 75,300 acres were treated. Some areas originally designated to be treated were deleted because anticipated epidemic populations did not materialize.

In areas designated for microbial pilot projects, populations either did not materialize or declined due to natural factors early in the larval feeding period; therefore, these projects were aborted. Sampling of designated spray and check blocks following abortion of these projects showed an average natural reduction of 93 percent, 14.4 percent of which was directly attributable to parasitism, predation, and attack by a naturally occurring virus.

Pilot projects with Sevin-4-oil and *B. thuringiensis* in Montana were conducted according to plans on vigorous Douglas-fir tussock moth populations. Prespray population levels averaged 84 larvae per 1,000 square inches of foliage. Approximately 200 acres of privately owned lands were treated with *B. thuringiensis* near Lolo, Montana. A population reduction of 73 percent was achieved after 14 days. An additional 800 acres of private land in two blocks were treated by helicopter with Sevin-4-oil at the rate of 2 pounds in three-fourths gallon of carrier per acre. Spray was applied to first instar larvae. Control was 95.8 and 99.4 percent in the two areas. An additional pilot test of Sevin-4-oil was conducted in Idaho on 1,320 acres. Larval populations in the two sprayed areas were reduced by 95.5 and 96.7 percent.

Late in 1974 a new outbreak of Douglas-fir tussock moth was discovered in Lake County, Montana, on the Flathead Indian Reservation. Approximately 10,000 acres northwest of Polson, Montana, along the south shore of Flathead Lake, are infested. Three localized spot infestations also occur in the Jocko River Valley, Montana. Egg mass surveys indicate that sufficient larval populations will emerge to cause additional defoliation in 1975.

Figure 2.--Areas of Douglas-fir tussock moth infestation, Northern Region, 1974.

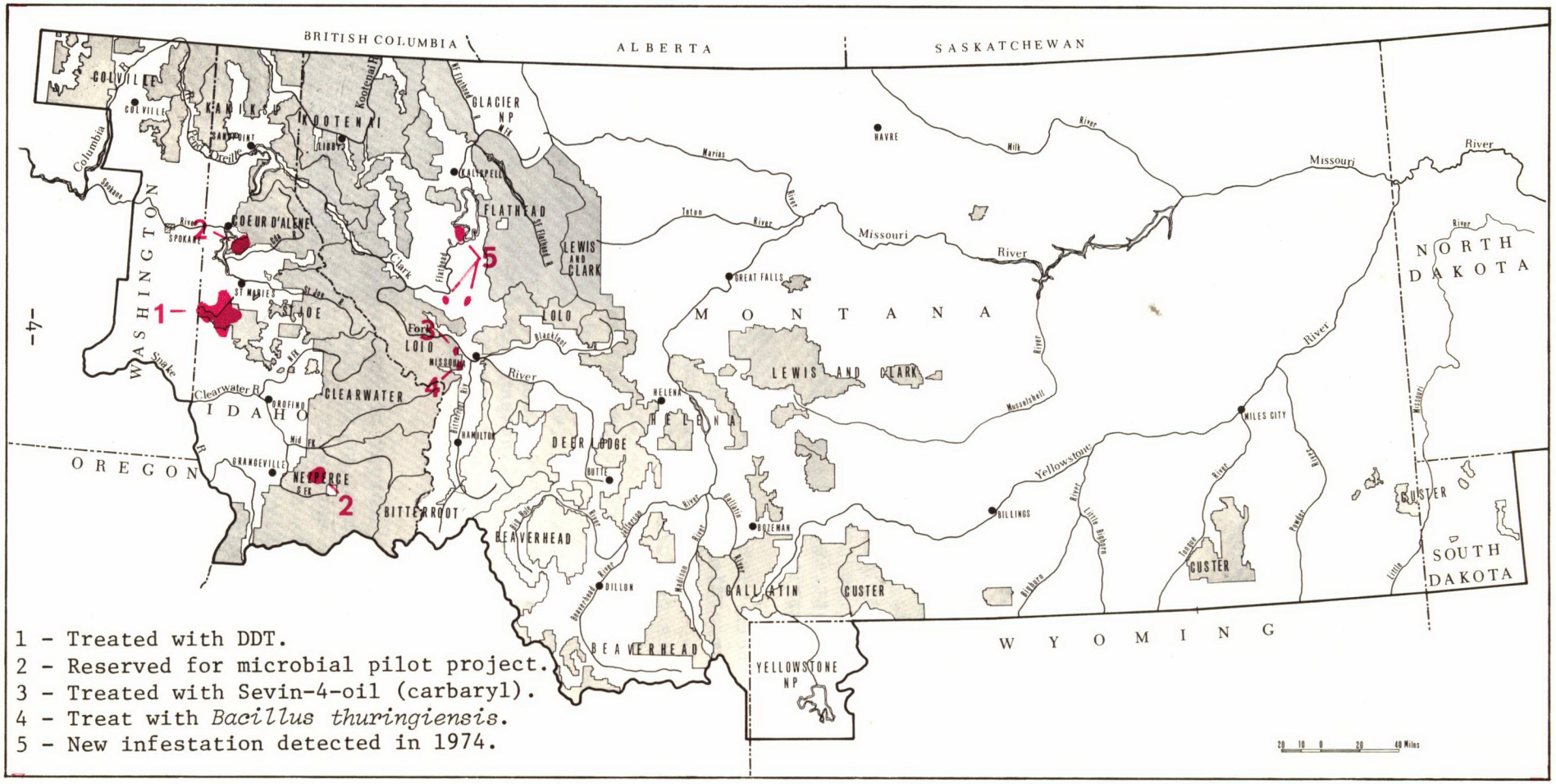


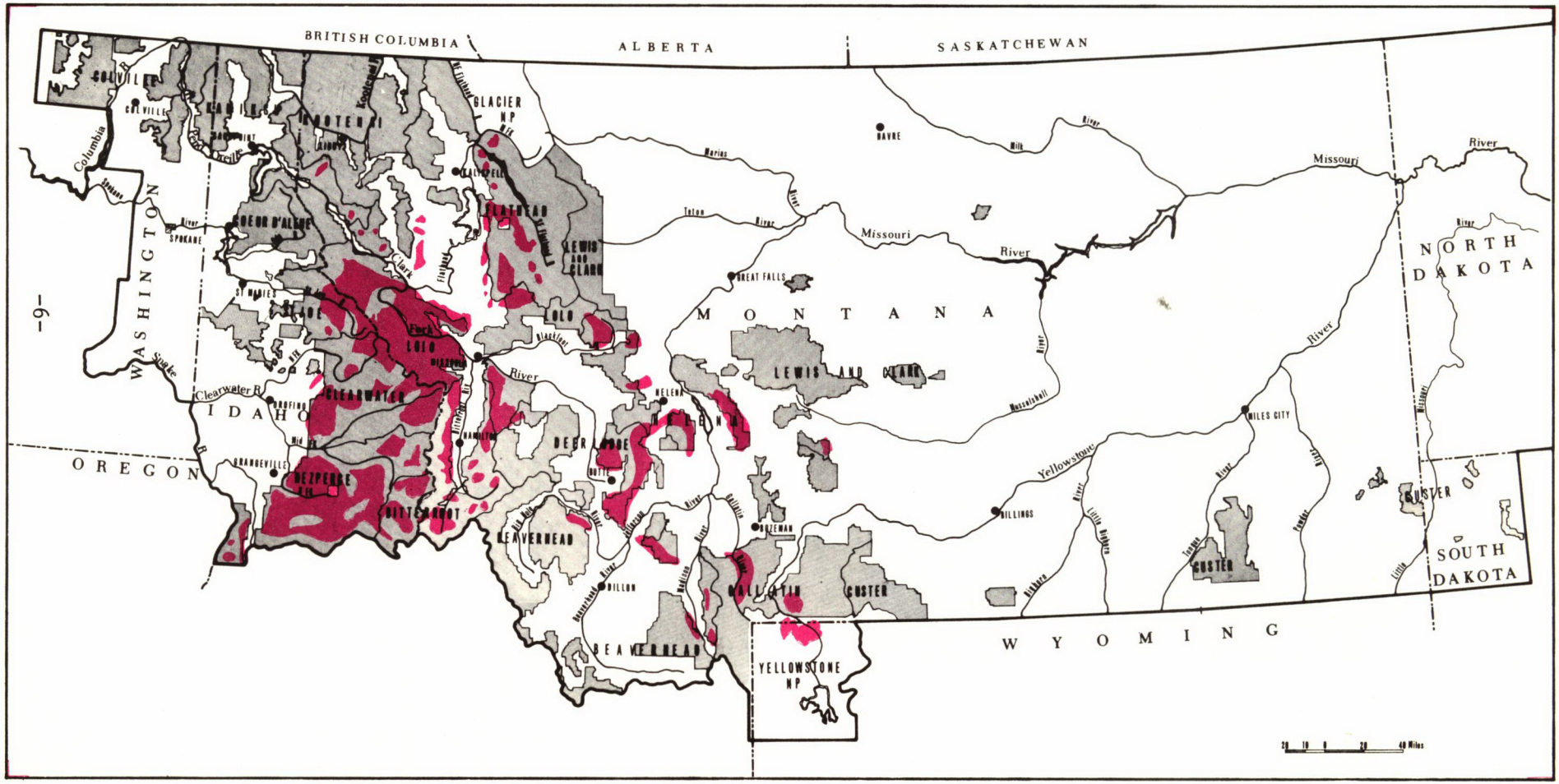
Figure 3.--Helicopter spraying of Douglas-fir tussock moth infestation, 1974.

WESTERN SPRUCE BUDWORM, *Choristoneura occidentalis* Freeman. Western spruce budworm defoliation occurred on 4,180,385 acres in Region 1 during 1974 (Figure 4). This represents an increase of 614,525 acres of visible defoliation over 1973. Greatest defoliation increases were noted in Montana on forested lands east of the Continental Divide. Defoliation increased in these areas from 166,530 acres in 1973 to 689,252 acres in 1974 (Table 1).

In Montana, fall egg mass surveys revealed high counts on forests east of the Continental Divide. New egg masses averaged approximately 20 egg masses per 1,000 square inches of foliage. This is sufficient to result in approximately 55 percent of the new shoots being damaged.

Continued budworm defoliation on the Flathead National Forest, Montana, is resulting in top kill of subalpine fir, Engelmann spruce, and Douglas-fir. A significant decline in budworm defoliation occurred on the Nezperce National Forest, Idaho. This has been attributed to depletion of host type.

Figure 4.--Areas of western spruce budworm infestation, Northern Region, 1974.



Outlook for western spruce budworm populations for 1975 is for a significant increase in acres infested and intensity of defoliation in new areas east of the Continental Divide in Montana. A static to slightly increasing situation is expected in western Montana and northern Idaho. A downward trend in budworm populations is predicted for the Nezperce National Forest, Idaho.

Table 1.--Acres of aerially visible western spruce budworm defoliation, Region 1, 1973-74

Unit	Defoliation (acres)	
	1973	1974
Idaho		
Clearwater National Forest	414,680	591,479
Idaho Panhandle National Forests	146,000	204,841
Nezperce National Forest	1,321,000	1,182,823
Montana		
Beaverhead National Forest	14,500	48,770
Bitterroot National Forest	347,000	262,998
Deerlodge National Forest	78,320	268,237
Flathead Indian Reservation	119,560	104,679
Flathead National Forest	120,090	110,873
Gallatin National Forest	11,400	54,026
Helena National Forest	44,680	259,752
Lewis and Clark National Forest	350	18,534
Lolo National Forest	931,000	1,033,440
Wyoming		
Yellowstone National Park	17,280	39,933
Total	3,565,860	4,180,385

LARCH CASEBEARER, *Coleophora laricella* (Hbn.). Defoliation by larch casebearer continued during 1974. Foliar damage increased in larch stands on the Clearwater, Flathead, Idaho Panhandle, Kootenai, and Lolo National Forests.

In a continuing effort to establish biological control agents, two new parasitic wasps were introduced into infested larch stands near Evaro, Montana. A total of 745 *Necremnus metalarus* (Walker) and 112 *Elachertus argissa* (Walker) were released in selected stands. During 1974

additional releases of the parasite *Chrysocharis laricinellae* (Ratz.) were also made. Collections and evaluations of these parasites are continuing to determine their establishment and efficacy.

WESTERN FALSE HEMLOCK LOOPER, *Nepytia freemani* Munroe. Infestations of this defoliator declined during 1974. Area of visible defoliation was approximately the same as during 1973 (approximately 3,000 acres); however, intensities of looper damage decreased considerably. Defoliation was restricted to the northern portion of the Flathead Valley, Montana. New spot infestations were detected in the Stillwater drainage. Some top kill occurred on defoliated trees near Kalispell, Montana.

An egg mass survey showed an average of about 12 eggs per square foot of foliage in the fall of 1974 compared to 38 eggs per square foot of foliage in 1973. This is enough eggs to cause light to moderate defoliation in 1975 but little if any additional permanent injury (tree mortality or top kill) is anticipated in 1975.

Several natural parasites, a tachinid, *Cermoasia auricaudata* Tns., and two ichneumonids, *Phobocampe* sp. and *Apechthis* sp., were observed in the fall of 1973 and may have been responsible for suppressing looper populations during 1974.

PINE NEEDLE SHEATH MINER, *Zelleria haimbachi* (Busck). Damage caused by the pine needle sheath miner continued in the Northern Region during 1974. Defoliation intensity and areas of infestation increased on the Flathead, Gallatin, and Idaho Panhandle National Forests. Moderate to heavy defoliation of current year's growth occurred on approximately 57,500 acres of lodgepole pine between Martin City, Montana, and Lake McDonald, Glacier National Park. Heavy defoliation occurred on 28,700 acres on Flathead National Forest lands. Approximately 1,200 acres were moderately defoliated near Yankee Creek, Gallatin National Forest, northwest of Bozeman, Montana.

A new area of activity developed between Weyer Gulch and Gold Creek on the Wallace Ranger District, Idaho Panhandle National Forests, Idaho. Defoliation varied from moderate to heavy with about one-half the infested area heavily defoliated. Approximately 15,000 acres of private lands were heavily damaged near Rathdrum Prairie about 7 miles north of Coeur d'Alene, Idaho.

In Montana populations of pine needle sheath miner are often associated with infestations of the sugar pine tortrix, *Choristoneura lambertiana* (Busck); however, in 1974, *C. lambertiana* populations remained at endemic levels while *Z. haimbachi* populations were responsible for visible damage. Parasite collections at Rathdrum Prairie, Idaho, and near Martin City,

Montana, indicated that two parasites, an ichneumonid, *Chelonus (Microchelonus) acutiguster* McComb, and two chalcids, *Spilochalcis albifrons* (Walsh) and *Spilochalcis leptes* Burks, are exerting some control against Z. *haimbachi* populations.

WESTERN HEMLOCK LOOPER, *Lambdina fiscellaria lugubrosa* Hulst. Infestations of this looper declined during 1974. Very light defoliation continued on the Canyon Ranger District, Clearwater National Forest. A new infestation occurred near Hope, Idaho, Idaho Panhandle National Forests; however, overall populations are not expected to increase in 1975.

MAJOR BARK BEETLES

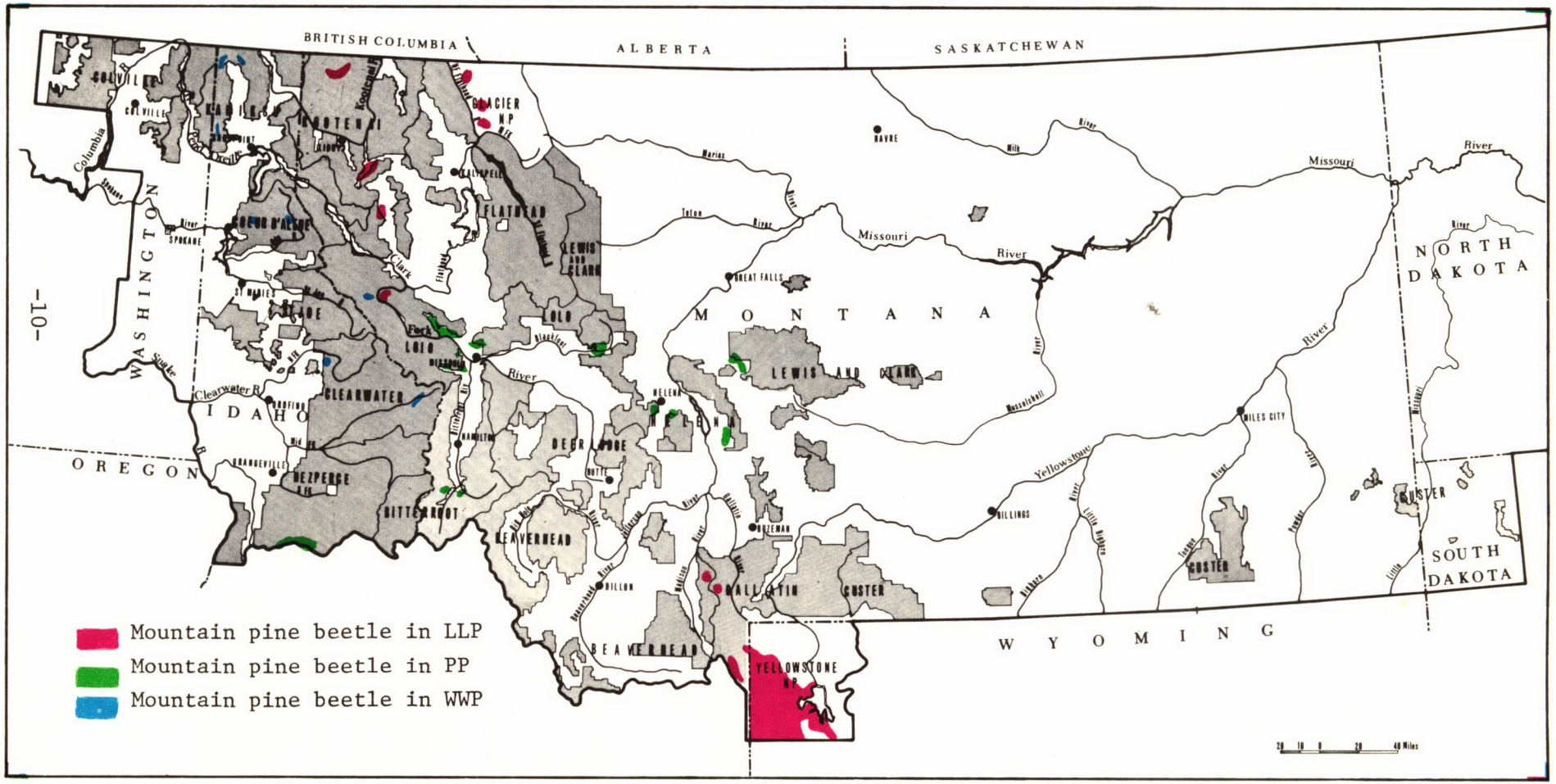
MOUNTAIN PINE BEETLE, *Dendroctonus ponderosae* Hopk. Mountain pine beetle continued as the number one bark beetle pest in the Northern Region in 1974 (Figure 5).

Infestations in lodgepole pine: In the Gallatin River drainage, south of Bozeman, Montana, a spectacular increase in number of lodgepole pine killed occurred from 1973 to 1974 at about a 1:4 ratio. An estimated 81,000 trees with a volume of 1,500,000 board feet were infested on 5,200 acres in 1974. On the Hebgen Lake Ranger District, Gallatin National Forest, Montana, scattered groups of infested trees occurred near Teepee Creek north of West Yellowstone, Montana, and from Rumbah Ridge near Hebgen Lake south to Black Bear Canyon. Groups varied in size from 5 to 100 infested trees per group. Plots in the area showed an average of 2.5 infested trees per acre. This infestation is expected to continue in stands containing susceptible trees in 1975.

New outbreaks of mountain pine beetle developed on the Beaverhead National Forest, Montana. Over 1,800 infested trees occurred in mixed stands on about 780 acres of Burlington Northern and U.S. Forest Service lands in the Jack Creek drainage 10 miles east of Ennis, Montana. Several hundred current year's faders were mapped on the Madison Ranger District. Extensive tree mortality resulting in heavy volume losses is expected during the next 5- to 6-year period due to the number of large diameter trees currently infested; the amount of bark beetle brood that will emerge from these trees; and the fact that a large amount of the susceptible volume is in a proposed wilderness area which cannot be logged.

Infestations expanded in Beaver Creek and Solo Joe Creek in the Yaak River drainage, Kootenai National Forest, Montana. A survey of the Beaver Creek outbreak showed 1,958 currently infested trees on 380 acres. A survey of 320 acres in the Wolf Creek drainage, Fisher River

Figure 5.--Areas of mountain pine beetle infestation, Northern Region, 1974.



Ranger District, showed a 1:1.4 increase from 1972 to 1973 and a 1:1.7 increase from 1973 to 1974 in number of currently infested trees. In this area 6,554 trees were infested with a potential volume loss of 529,908 board feet. An increase in tree and volume losses is predicted on the Kootenai National Forest in 1975.

The Yellowstone National Park infestation reached a stable condition in 1974. About 1,845,000 lodgepole pine were infested on about 275,200 acres. The outbreak slowed its northward spread with infestations now occurring from where U.S. Highway 191 enters the park along the west edge, southeast through Madison Valley, encircling Yellowstone Lake, then south through the Yellowstone thoroughfare to Grand Teton National Park.

Epidemics occurred in mixed stands on approximately 4,630 acres in Glacier National Park. Groups of faders, up to 100 trees per group, occurred in the Camas, Dutch, and Quartz Creek drainages. Survey data taken on quarter-acre plots indicate a 1:10 buildup ratio in number of infested trees from 1973 to 1974. About 178,700 trees are currently infested. This outbreak is expected to intensify in 1975.

On the Lolo National Forest several hundred faders were mapped on about 5,000 acres in Meadow and Lazier Creek drainages, tributaries of Thompson River, Thompson Falls Ranger District. An increase in number of trees killed occurred between Slowway Gulch throughout stands at Four Mile Flats, northwest along the Clark Fork River to St. Regis, and in the lower Mill Creek drainage. Approximately 2,600 trees are infested on about 3,800 acres in both areas. Scattered, relatively light infestation has developed in Chicken and Quartz Creeks near Rivulet, Montana, and in Brushy, Verde, and Westfall Creeks near Lozeau, Montana.

Infestations in ponderosa pine: Infestations occurred in second-growth stands in the West Fork Bitterroot drainage, Bitterroot National Forest, Montana. Heaviest losses occurred on the north side of Shook Mountain and on private lands nearby. In excess of 1,200 trees have been killed in these areas. Infestations also continued on the Ninemile Ranger District, Lolo National Forest. Commercial thinning of overstocked stands was conducted to reduce population increases. A total of 57,747 trees with a volume of 3,226,000 board feet were removed. During the 1974 aerial detection survey approximately 4,000 trees were mapped on about 8,500 acres in this area. Scattered infestations continued in tributaries of the Blue Mountain area and in Lolo Creek, Missoula Ranger District. In excess of 8 million board feet of second-growth ponderosa pine are scheduled for thinning to reduce beetle losses and enhance tree growth on the Ninemile District in 1975.

Several hundred ponderosa pine were killed between Marshall and Johnson Creeks on State, private, and National Forest lands northwest of Missoula, Montana. Lighter infestations occurred in the Blackfoot River drainage, Montana.

Infestations increased on mixed State, private, and National Forest lands in the Pear, Dutchman, and McClellan Creek drainages, and scattered groups varying in size from two to 50 trees per group were detected at Clancy Creek north to Colorado Gulch on the Helena District south of Helena, Montana. Over 3,100 infested trees occur in scattered groups throughout these drainages. Infestations are at a low level in mixed lodgepole-ponderosa pine stands on the Lincoln District, Helena National Forest, Montana. However, an increase in activity is predicted for ponderosa pine stands in this area.

An upsurge in number of trees killed in 1974 occurred in the Black Tail Creek-Shannon Creek and tributaries of the Tenderfoot drainage, White Sulphur Springs District, Lewis and Clark National Forest, Montana. Groups of faders with up to 100 trees in each group were mapped. Static infestation continued on Monarch Mountain and Pilgrim Creek on the Belt Creek District, Lewis and Clark National Forest, Montana.

Mountain pine beetle infestations continued for the second consecutive year on and near the Crow Reservation, Montana. Approximately 100 acres of newly infested trees occurred in the north fork of Indian Creek and the main Indian Creek drainage north of an area where 2,086,543 board feet of timber were salvage logged from Bureau of Indian Affairs lands and an equal amount from private lands.

Infestations in western white pine: Mountain pine beetle activity decreased throughout most of northern Idaho in 1974. Scattered groups varying from three to 15 infested trees per group occurred on the Powell and Canyon Ranger Districts, Clearwater National Forest. Scattered infestations occurred in Sylvan and Tamarack Creeks on the Clearwater Ranger District, Nezperce National Forest. Infestation levels on industrial and State lands between Orofino and Headquarters, Idaho, appear to have declined.

DOUGLAS-FIR BEETLE, *Dendroctonus pseudotsugae* Hopkins. The massive outbreak of this beetle in the North Fork Clearwater River drainage in Idaho declined for the third consecutive year. Infested groups seldom exceeded 30 attacked trees as compared to groups of 100 or more in 1971 and 1972. Brood sampling revealed, however, that there was a reversal in the trend of brood to adult ratios. Reasons for this are unknown, but may be attributed to lower predator or parasite populations, lower attack density, or drought conditions in 1973. A large adult flight may occur next spring resulting in increased attack and infestation spread.

PINE ENGRAVER BEETLE, *Ips* spp. The extremely dry climatic conditions which prevailed in 1973 resulted in increased *Ips* activity in northern Idaho and Montana. In excess of 1,400 trees were killed on the Lolo National Forest. Several 20-tree groups occurred in the North Fork of Lolo Creek, between Hayes Creek and Lyon Creek; and between Sherman Gulch and Dry Gulch on mixed State, private, and Federal lands. Additional infestation occurred along the Clark Fork River drainage, west of Missoula, Montana. Several 30- to 100-tree groups developed in Herbert Creek, Quartz and Brushy Creek drainages, Superior District, Lolo National Forest, Montana. On the Thompson Falls District, infested tree groups occurred in Clark Creek, West Fork of Miller Creek, and near Thompson Falls, Montana.

An estimated 600 ponderosa pine were killed in the Bitterroot National Forest, Montana, in 1974. Group kills developed in Cameron, Lyman, and Sula Creeks, Sula Ranger District; and between Swamp and Nelson Creeks, West Fork Ranger District. Heavy infestations occurred in Woodchuck and Sluice Creek drainages on the Stevensville Ranger District.

Approximately 2,200 ponderosa pine were killed by *Ips* spp. on the Flathead Reservation between Evaro and Perma, Montana. Mortality is concentrated in the lower Middle Fork of the Jocko River between North Lamoose Creek and Dry Creek, south of St. Ignatius, and from Mike's Creek north to Boulder Creek on the east side of Flathead Lake. Additional infestations were detected between Spring Creek and Hog Haven Draw west of Elmo, Montana. Several groups of up to 40 infested trees per group developed in the Mill Creek drainage west of Missoula, Montana.

In Idaho scattered infestations of *Ips* spp. occurred on private lands between Baker and Sage Creeks and between Bronco Junction and the Farragut wildlife management area. Approximately 170 ponderosa pine trees were killed along Blossom Mountain Road, north of Pleasant View, Idaho. Localized killings of lodgepole pine occurred between Cocollala and Vay, Idaho, and between Blanchard, Idaho, and Newport, Washington.

Epidemic populations developed on about 550 acres of National Forest land south of Edgemere near Hoodoo Lake, Sandpoint Ranger District, Idaho Panhandle National Forests, Idaho. Buildup in this area resulted from thinning. Infested stands were in an overstocked, stagnated condition and once the reservoir of beetles reached epidemic level in slash, beetles invaded standing green trees. Commercial thinning and chipping is in progress to remove infested trees and improve stand vigor.

FIR ENGRAVER, *Scolytus ventralis* LeConte. Tree mortality caused by the fir engraver increased in grand fir stands on the Clearwater, Idaho Panhandle, and Nezperce National Forests in northern Idaho in 1974. Most severe tree mortality occurred in 80- to 100-year-old stands on the Nezperce National Forest where an estimated 17,000 trees were killed on 20,000 acres. In the Idaho Panhandle National Forests over 8,000 trees were killed on 7,400 acres with heaviest mortality occurring on the Fernan and Wallace Ranger Districts. Approximately 700 trees were killed on 2,000 acres between Canyon Meadows and the Middle Fork Clearwater River, Pierce Ranger District, Clearwater National Forest. The Clearwater National Forest salvage logged over 800,000 board feet of timber to reduce potential losses by this beetle.

Scattered infestations of fir engraver occurred near Kamiah, Rathdrum, Coeur d'Alene, and Cataldo, Idaho, and near Priest and Spirit Lakes, Idaho. In Montana isolated infestations developed on the Flathead and Lolo National Forests.

OTHER INSECTS

DEFOLIATING WEEVIL, *Magdalis gentilis* LeConte, (Figure 6). This weevil damaged 700 acres of precommercially thinned lodgepole pine on the Lewis and Clark National Forest. Recurring outbreaks of *M. gentilis* have been observed at varying intensities since 1965. Defoliation by the beetle is directly related to times of stand thinning. Areas thinned prior to late July suffer heaviest losses. Damage is restricted to current year's foliage and infestations in any one thinning area do not persist for more than one growing season. Therefore, trees usually recover following single season weevil attacks. If recommended thinnings are adhered to, damage can be minimized.

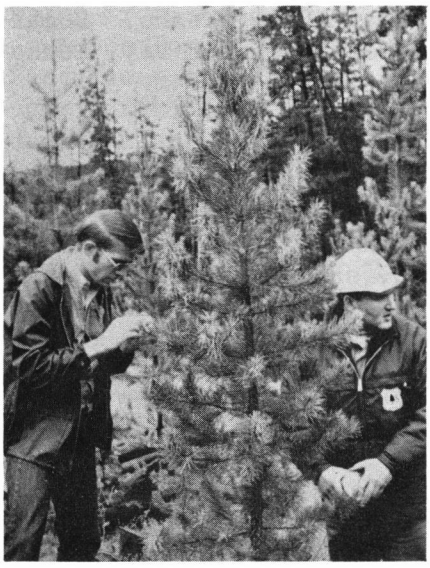


Figure 6.--Examination of *Magdalis gentilis* LeConte feeding damage on lodgepole pine, Lewis and Clark National Forest, Montana.

FOREST TENT CATERPILLAR, *Malacosoma disstria* Hbn. The forest tent caterpillar defoliated *Populus* spp. and other hardwoods in river basins in northern Idaho. Heavy defoliation was also observed along the Jocko River and near Evaro, Montana. Severe tree damage has not resulted since trees refoliate following feeding.

ASH BORER, *Podosesia syringiae fraxini* (Lugger). An active infestation of this borer occurs in shelterbelt plantings of green ash around the Bowman-Haley reservoir in southwestern North Dakota. Infestations of this pest have continued since prior to 1972 when 51 percent of North Dakota shelterbelts containing green ash trees were infested. The current infestation involves approximately 40 percent of the ash trees adjacent to the reservoir. Sampling surveys indicate that sufficient adult populations exist to maintain high levels of damage in 1975.

DOUGLAS-FIR NEEDLE MINER, *Contarinia* sp. A Douglas-fir needle miner infestation has been reported for the third year in the western portion of the Region. The Colville, Idaho Panhandle, Kootenai, and Nezperce National Forests have all experienced infestations of this pest. The current outbreak is causing an economic impact in areas managed for Christmas tree production. Needle mining by larvae causes needle loss and discoloration, making trees unacceptable for marketing.

LODGEPOLE TERMINAL WEEVIL, *Pissodes terminalis* Hopkins. This weevil top-killed approximately 40 acres of ponderosa pine on the Colville National Forest. Killing of the terminal leaders has destroyed much of the merchantable value of trees. Populations may be expected to increase as stands reach maturity, are logged, and reproduction becomes dominant.

ALDER FLEA BEETLE, *Altica bimarginata* Say. Both larval and adult stages of this leaf skeletonizer defoliated alder along roadsides and riverbeds in western Montana and northern Idaho. In some places shrubs were completely denuded over considerable areas.

CALIFORNIA TORTOISE SHELL BUTTERFLY, *Nymphalis californica* (Bdv.). Larvae of this butterfly caused extensive defoliation on several species of *Ceanothus* on the Kootenai and Lolo National Forests in Montana. Larval parasites (Figure 7), including *Hyposoter annulipes* (Cr.), have been responsible for some population reductions.

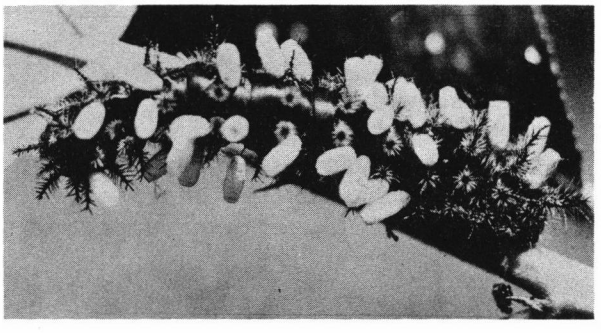


Figure 7.--Ectoparasitized larva of the California tortoise shell butterfly.

PINE NEEDLE SCALE, *Phenacaspis pinifoliae* (Fitch). A heavy infestation of the pine needle scale occurs on nearly 100 acres of lodgepole pine near Elliston, Montana, Helena National Forest. Large numbers of scales caused loss of 2-, 3-, and 4-year-old needles resulting in overall defoliation and some tree mortality.

SEED AND CONE INSECTS. A number of seed and cone insects, including the western spruce budworm, (*Choristoneura occidentalis* Freeman), caused problems in the Northern Region during the year. An evaluation of the chemical spray Dimethoate was conducted on the Nezperce National Forest, Idaho. Two concentrations (0.5 percent and 0.25 percent) of the insecticide were applied.

STATUS OF FOREST DISEASES

Conditions in Brief

Sulfur dioxide damage to vegetation is evident near Anaconda, East Helena, and Missoula, Montana. Fluorides continue to cause damage near Columbia Falls, Montana. Substantial deposits of heavy metals are present on vegetation near an antimony smelter south of Thompson Falls, Montana. Root diseases have caused considerable damage in northern Idaho and are more prevalent in western Montana than formerly thought. *Poria weirii* and *Armillariella mellea* were the primary causal agents. *A. mellea* was found on roots of a dead juniper; this is a new host record for Montana. Stem decay is widespread and continues to be a major factor in timber production. An economic analysis of dwarf mistletoe control shows a benefit/cost ratio of 3.25/1 in Douglas-fir and western larch and 2.42/1 in lodgepole pine. Seedling mortality at the Coeur d'Alene Nursery ranges from one to 70 percent, depending on species and seed sources. Soil microflora and soil chemical and physical properties are being investigated. Fumigation practices and chemical fungicides are being evaluated at the nursery. About 145,000 western white pine seedlings, resistant to *Cronartium ribicola*, were planted in 1974. These were the first commercial plantations of genetically improved seedlings in the history of the Northern Region.

Airborne industrial effluents: A field survey of continuing sulfur dioxide (SO_2) damage to forest vegetation was made in 1974 near the Anaconda copper smelter at Anaconda, Montana. This smelter reportedly emits nearly 750 tons of SO_2 to the air each day (Figure 8). Typical SO_2 damage was found on Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, ponderosa pine, *Pinus ponderosa* Laws, and limber pine, *P. flexilis* James. Several understory species known to be sensitive to SO_2 also showed typical markings. Much of the land around the smelter formerly supported an extensive coniferous forest but an area of 10 to 15 miles radius was virtually inundated by smelter fumes in the early 1900's, soon after the smelter began production (Figure 9). Today, existing vegetation in the polluted area apparently

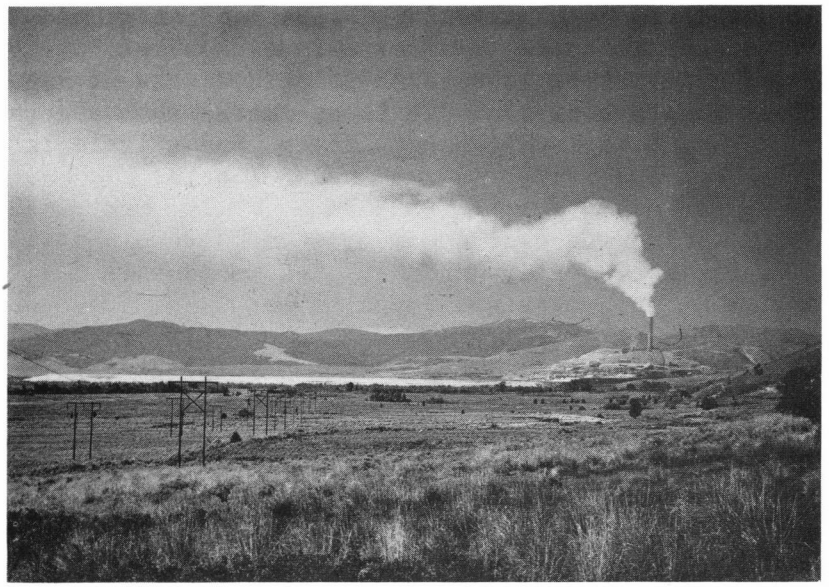


Figure 8.--Anaconda copper smelter emits about 750 tons of SO_2 to the atmosphere each day.

Figure 9.--Fumes from the Anaconda copper smelter have virtually eliminated coniferous forest for up to 10 miles distant.

shows varying amounts of resistance to the pollutant. However, necrosis of photosynthetic tissue of existing vegetation contributes substantially to its unthrifty appearance. Measurements of ambient SO_2 by the State of Montana showed concentrations several-fold in excess of amounts known to be deleterious to plant tissue. It is estimated that vegetation on more than 50,000 acres of National Forest, State, and private lands shows varying degrees of SO_2 damage in the Anaconda area.

Sulfur dioxide damage was also documented on ponderosa pine and Douglas-fir near the American Smelting and Refining Company lead smelter at East Helena, Montana. The damage was found on nearly 6,500 acres of private land within 5 miles of the smelter. Here, as in Anaconda, the State of Montana recorded SO_2 concentrations substantially greater than amounts known to cause injury to plant tissue.

Fluorides continue to be a serious problem at Columbia Falls, Montana. Anaconda Aluminum Company increased production in 1974 as a result of adequate energy and a good aluminum market. Fluoride injury to 1974 tissue was found on lodgepole pine, *Pinus contorta* v. *latifolia* Engelm., western larch, *Larix occidentalis* Nutt., and herbaceous indicator plants up to 5 air miles (25,000 acres) from the aluminum plant. Damage appeared to have increased to levels observed in 1970. An epidemic insect infestation of a needle sheath miner, *Zellaria haimbachi* (Busck), and a needle miner, *Ocnerostoma strobivorum* (Zeller), was statistically related to ambient and foliar fluoride concentrations in lodgepole pine in the polluted area. The data strongly indicated that fluoride is a contributing factor in predisposing pines to damage by these insects. A preliminary inquiry into the influence of the fluoride-insect complex on diameter growth of lodgepole pine revealed that an average loss of 57 board feet per acre per year has been sustained since 1968. Assuming that 20,000 acres of lodgepole pine are affected, nearly 6 million board feet of wood has been lost, and this does not include mortality.

A sulfur complex consisting of hydrogen sulfide, mercaptans, and SO_2 emitted from the Hoerner Waldorf pulp and paper mill at Missoula, Montana, continued to cause damage to Douglas-fir and ponderosa pine west of the pulp mill. Sulfation rates as measured by sulfation plates continued to demonstrate that large quantities of sulfur compounds impinge the affected area. Although the damage was not as severe this year as in 1972-73, vegetation on more than 2,000 acres of State, private, and Federal lands showed symptoms of sulfur damage.

The first season's data from a SO_2 background study at Addy, Washington, relative to a magnesium plant being built by Alcoa, is nearly complete (Figure 10). This study is a joint effort by the Forest Service and Washington State University. Detailed ecological measurements in forest communities at varying distances from the facility have been taken.

Quantitative data on foliar insects, diseases, and mimicking SO_2 symptoms have been taken, and total sulfur analyses will be done on nearly 200 conifer foliage samples (Figure 11). In addition, the area (about 1,600 acres) was stereo photographed in color infrared at a scale of 1:6000.

Figure 10.--Plant site for Alcoa's magnesium facility being built at Addy, Washington.

Figure 11.--Special laboratory assistants measure insect, disease, and abiotic damage on conifer foliage from the Addy, Washington area prior to operation of a magnesium plant now under construction.

The Forest Service participated in formal court hearings and litigation on pollution sources in cooperation with the State of Montana and the Environmental Protection Agency in 1974. As a result, the Anaconda copper smelter, American Smelting and Refining Company, and Anaconda aluminum are under legal stipulation to comply with State of Montana air pollution standards within 3 to 5 years. Although damage to forest vegetation will not be eliminated, an improvement should be evident in the years ahead.

Analyses of vegetation near a small antimony smelter south of Thompson Falls, Montana, revealed substantial deposits of heavy metals on conifer foliage. Of primary concern were oxides of antimony. Antimony acts very similar to arsenic in its toxicological properties and could pose a serious threat to animal life in the fallout area.

Several important questions relative to vegetation expression of air pollution symptoms were raised. The nature of damage to different tissues by different pollutants has not yet been answered satisfactorily. The influence of acid sulfate aerosols and the mode of action of organic and reduced sulfurs still needs to be well defined. These questions may be answered by current Forest Service, State of Montana, and University of Montana studies.

Root diseases: The data-gathering phase of a root disease impact survey on the Coeur d'Alene National Forest was completed this year. A double sampling design utilizing color infrared photography and a ground sample was employed. The survey was superimposed over areas included in the recently completed timber inventory survey on that Forest so that existing stand information and expansion factors could be used.

Approximately 20,000 acres (376 stands) were photographed and ground checked. Data has not yet been analyzed or expanded; however, preliminary results are as follows:

1. About one-third of stands had root disease centers with area affected ranging from less than 1 to over 70 percent.

2. Of stands with root disease centers, 17 percent of total area was involved in the centers.

3. Over all stands surveyed, 6 to 7 percent of total area was occupied by root disease centers.

4. Causal agents were primarily *Poria weirii* (Murr.) Murr. and *Armillariella mellea* (Vahl ex Fr.) Karst. (Figure 12).

5. Photo interpretation accuracy was about 95 percent, but types of stands where errors were encountered have been identified. By eliminating these, accuracy was increased to 99 percent.

Figure 12.--Nineteen-acre root disease center caused by *Armillariella mellea*.

Based on data collected in doing a timber inventory, in nearly 90 percent of the cases, root disease was found on:

1. *Tsuga* series habitat types. (However, we feel that it also occurs on drier sites than this.)

2. Three soil types, all of which have the same general soil structure.

3. Sites with indexes of 75 or better.

4. Stands composed of predominantly Douglas-fir or grand fir (*Abies grandis* (Dougl.) Lindl.).

5. Mid to upper slopes from 25 to 75 percent.

6. Southerly, easterly, or westerly aspects.

As a followup to last year's finding of *Fomes annosus* (Fr.) Cke. in roots of newly dead, mature ponderosa pine in the Hot Springs and Arlee, Montana, areas, several newly dead, mature pines were dynamited to expose root systems. Decay or other signs of root pathogens were not found; however, tap roots were not exposed. Mature *F. annosus* sporophores were found on roots of one tree in the Hot Springs area found to have the fungus in 1973.

Root disease centers, apparently being caused by *Armillariella mellea*, are more frequent in western Montana than formerly thought. In addition to the 20-acre "hole" in the Seeley Lake area, mentioned in previous year's reports, several more, ranging from one-half to several acres in size, have been detected in the same area as well as near Lincoln. In one, *A. mellea* was found colonizing roots of dead *Juniperus scopulorum* Sarg., a new host record for the State.

The fungus continues to cause occasional mortality in young stands throughout the Region and in prime mature Douglas-fir stands in northern Idaho.

Now that the Region is thinning more sapling and pole-sized stands, other problems are becoming evident. In one young western larch stand in the Upper Brett Creek drainage of the Idaho Panhandle National Forests, butt decay near ground line was found. Based on decay columns and cultures isolated therefrom, the causal agent has been tentatively identified as *Polyporus tomentosus* Fr. (Figure 13). Decay was apparently confined to a number of western larch trees located on one edge of the thinning area. Mortality was not evident.

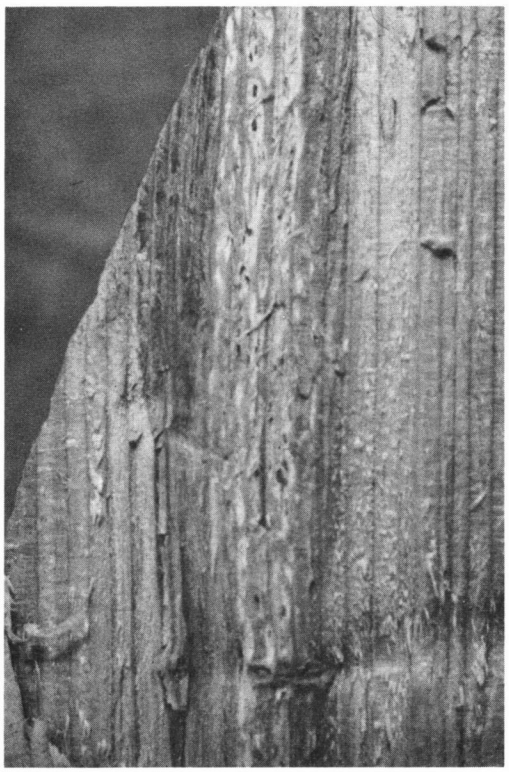


Figure 13.--Butt decay in western larch caused by *Polyporus tomentosus*.

Some 3,000 acres in the Pleasant Creek drainage near Coeur d'Alene, Idaho, were photographed with color infrared film to determine severity and location of root disease centers. Ultimate use of the photography is for management planning for the area. As of this time, photos have been evaluated but ground checking has not been completed. Photo evaluations indicate that considerable area is involved in the root disease centers.

In cooperation with the Intermountain Forest and Range Experiment Station, study areas designed to test effectiveness of several management alternatives to reduce losses from root disease, and to bring under management areas understocked due to root disease, have been installed in the Lonesome Creek area of the Idaho Panhandle National Forests. Studies are on a long-term basis.

A mortality survey in the Binarch Creek drainage near Priest Lake, Idaho, originally designed to determine efficacy of 35 mm photography in identifying root disease centers, was completed in 1974. Data analysis is not complete; however, preliminary results indicate that 35 mm photography is useful in locating and counting dead trees over large areas. Sampling error with several film and filter combinations was less than 20 percent. Mortality estimates of five to six trees over 5 inches diameter at breast height (d.b.h.) per acre in recently salvage-logged areas, 10 to 12 trees over 5 inches d.b.h. per acre in unlogged areas, and 9 to 10 high-risk live trees per acre over the entire area were found. Mortality and high risk were due to a variety of causes, with major agents being white pine blister rust and a number of root pathogens.

Stem decays: In the Northern Region, stem decay is widespread and continues to be a major factor in timber production. Observations in one young western larch stand on the Idaho Panhandle National Forests showed many individuals to have had tops broken some 5 to 10 years previously, possibly by a heavy snow pack. Several trees with these old broken tops were dissected longitudinally, and examined for presence of decay. Small decay columns were found originating from the broken top, with isolations therefrom yielding *Stereum sanguinolentum* (Alb. & Schw. ex Fr.) Fr., a common stem decay pathogen in the Region.

Dwarf mistletoes: Dwarf mistletoe, (*Arceuthobium americanum*, (Nutt. ex Engelm.)) growth impact study plots in lodgepole pine, installed in 1971, were remeasured in 1974. Considerable latent infection was present in 1971, as evidenced by the number of new infections found in 1974. Nearly all the infected trees present are Class 1 or 2 on the 6-Class scale; observations so far indicate that infection levels below Class 3 have no measureable impact on tree growth. This leads us to believe that stocking density plays a much larger role in tree growth than dwarf mistletoe infection, at least during the early years of stand development.

An economic analysis of dwarf mistletoe control shows a benefit/cost ratio of 3.25/1 in Douglas-fir and western larch and 2.42/1 in lodgepole pine. These ratios are based on primary resource values and do not include value added to the economy in wages and social benefits.

Approximately 4,000 acres of dwarf mistletoe control was accomplished. Nearly all control expenditures were from timber management funds.

Seed production of the Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., was extremely low this year.

Nursery diseases: Seedling mortality, apparently due to root pathogens (*Fusarium* spp.) was abundant at the Coeur d'Alene Nursery. Attempts are being made to determine if indeed a problem exists, and if so, how significant it is and what can be done about it.

In mortality plots established in 1974, seedling mortality was highly variable between species, between seed sources, and somewhat variable between beds of a given seed source. As of early September, losses in 1-0 stock were greatest in grand fir, Douglas-fir, and western larch; and least in Engelmann spruce *(Picea engelmannii* Parry*)* and the pines, although observations suggest that losses are increasing in spruce late in the year. Average seed source losses for grand fir, Douglas-fir, and western larch are 25 to 35 percent and in some individual plots, range up to 70 percent. In spruce and pines, average losses amount to 1 to 10 percent and range up to 40 percent. At least 5 to 10 percent mortality is expected in these same beds next year.

In order to develop monitoring systems to predict disease severity in nursery beds, soil pathogen populations were determined for each mortality plot. The benefits of preventative types of control measures are obvious.

As a step toward understanding cultural control measures, correlation between soil microflora and soil chemical and physical properties are being investigated.

In order to minimize nursery disease problems until cultural treatments are available, chemical controls are being evaluated.

Fumigation of nursery beds has been a routine practice for the last 5 to 10 years, but significant losses are still occurring in some treated beds. Preliminary soil sampling data suggests that some beds are not being properly fumigated to reduce pathogen propagule levels.

Tests indicated that Benomyl applied at two rates, 7 and 14 pounds active ingredient per acre, and on two dates, were overall ineffective in reducing

mortality in 2-0 Engelmann spruce originating from two different seed sources and growing in three different nursery sections. However, more refined data analyses revealed that the material was beneficial in certain beds and apparently detrimental in others. A significant difference in mortality between seed sources was indicated.

A yet unsolved problem has been encountered in 1-0 pine lifted in November 1974. Nurserymen indicate that possibly a million seedlings may have to be culled due to some type of injury at, or 1 to 2 inches below, ground line. Physical injury, possibly due to worms, grubs, or rodents is evident on most seedlings. However, a few sunken, necrotic cankers have also been found, perhaps originating at a wound site. The problem is still being investigated.

Rust diseases: Spruce broom rust, caused by *Chrysomyxa arctostaphyli* Diet., was especially noticeable on Engelmann spruce near Hungry Horse, Missoula, and Helena, Montana.

Western gall rust, caused by *Endocronartium harknessii* (J. P. Moore) Hiratsuka, was prevalent on ponderosa pine in the Slim Buttes area near Camp Crook, South Dakota; and on lodgepole pine near Hungry Horse, Montana. More than 50 percent of lodgepole pine seedlings in a regenerated area on the Flathead National Forest were infected.

White pine blister rust, caused by *Cronartium ribicola* J. C. Fisch., is a continuing problem in the management of western white pine (*Pinus monticola* Dougl.). Considerable progress has been made in breeding planting stock resistant to this introduced fungus. About 145,000 rust resistant seedlings were planted in 1974 by two National Forests and three cooperators. About 60 percent of these planted trees are expected to survive rust infection to rotation age (80 years). These plantings were the first commercial plantations of genetically improved seedlings in the history of the Northern Region.

Non-rust needle diseases: *Rhabdocline pseudotsugae* Syd. caused moderately severe, widespread but spotty, defoliation of Douglas-fir in the Lochsa River drainage in northern Idaho, and in the lower Clark Fork River drainage of western Montana and northern Idaho. Unconfirmed field reports indicated minor amounts of mortality due to the pathogen.

Minor amounts of defoliation caused by the needle cast fungus *Hypodermella laricis* Tub. were found on individual western larch trees on the Idaho Panhandle and Kootenai National Forests. Occurrence of the fungus was very infrequent.

A fungus tentatively identified as *Lophodermella montivaga* (Petr.) Dearn. was associated with needle damage to lodgepole pine apparently confined to a 30- to 50-acre area in the Beaver Creek drainage of the Hebgen Lake Ranger District, Gallatin National Forest. Damage was first noted in late 1973, when many red needles were present. This year infection was again severe as noted by needle spots and red needles.

Widespread and locally heavy defoliation occurred on lodgepole pine in the Clark Fork River drainage approximately 20 miles on either side of the Idaho-Montana border. Causal agent was *Lophodermella concolor* (Dearn.) Darker.

Snow mold, caused by *Herpotrichia coulteri* (Pk.) Bose, was quite prevalent on lodgepole pine along the Clark Fork River near the Montana-Idaho border.

Miscellaneous diseases: Drought injury to ornamental Engelmann spruce was noticed in several locations throughout Montana. A 9-year-old lodgepole pine plantation on the Lewis and Clark National Forest showed widespread apparent drought injury during late fall.

Cottonwood, *Populus* spp., and maple, *Acer* spp., defoliation and branch dieback near the Missoula cemetery was found to be caused by the misuse of the herbicide Atrazine.

Severe detopping of lodgepole pine and western larch seedlings on a small area on the Flathead National Forest was postulated as being caused by large animals, probably moose, *Alces alces shirasi*.

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